

CLAIMS

What is claimed is:

1. A machine comprising:

5 an application chamber portion containing an application apparatus, the application apparatus is adapted to introduce a chemical mixture into contact with a substrate, wherein the chemical mixture comprises a non-aqueous solvent and a chemical solute, and wherein the substrate with the chemical mixture forms a wet substrate; and

10 a removal portion connected with the application portion wherein the non-aqueous solvent is removed from the wet substrate, leaving a substrate with remaining chemical solution.

2. A machine as set forth in claim 1, wherein the application apparatus is selected from a group consisting of a foam applicator, spray applicator, and a padding applicator.

15 3. A machine as set forth in claim 1, wherein:

20 the removal portion comprises a removal apparatus for removing a portion of the chemical mixture from the wet substrate, leaving a substrate with remaining chemical mixture;

25 a vacuum chamber in fluid communication with the removal apparatus for lowering a boiling point of the non-aqueous solvent in the substrate with remaining chemical mixture; and

an evaporator apparatus connected with the vacuum chamber to evaporate the non-aqueous solvent into a solvent vapor.

4. A machine as set forth in claim 3, wherein the removal apparatus is a squeeze roller.

5. A machine as set forth in claim 3, wherein the evaporator apparatus is a heat exchanger.

6. A machine as set forth in claim 5, wherein the heat exchanger is a steam-based
5 heat exchanger.

7. A machine as set forth in claim 3, further comprising:

10 a blower apparatus in fluid communication with the machine, creating a negative pressure and thereby preventing vapors from escaping; and

15 a separator connected with the blower apparatus to remove remaining solvent vapors.

20 8. A machine as set forth in claim 7, wherein the blower apparatus comprises an item selected from a group consisting of a fan, and a blower.

15 9. A machine as set forth in claim 7, wherein the separator comprises a mist
25 eliminator and a high efficiency separator, further removing solvent vapors.

10. A machine as set forth in claim 7, further comprising a collector portion for
20 collecting removed non-aqueous solvent.

11. A machine as set forth in claim 10, wherein:

25 the collector portion comprises a vapor scrubber chamber, where solvent vapor is pushed into the vapor scrubber chamber via the negative pressure;

20 a condensing apparatus associated with the vapor scrubber chamber, condensing the solvent vapor into a condensed liquid solvent solution;

25 a re-boiler tank in fluid communication with the vapor scrubber chamber and the removal apparatus, the re-boiler tank collecting the condensed liquid solvent solution and the portion of the chemical mixture into a collected solution,

where the collected solution is heated to vaporize the non-aqueous solvent into a re-vaporized non-aqueous solvent;

5 a cooling chamber connected with the re-boiler tank, where the re-vaporized non-aqueous solvent is condensed into a re-condensed non-aqueous solvent; and

a recovery tank associated with the cooling chamber to collect the re-condensed non-aqueous solvent.

12. A machine as set forth in claim 11, wherein the condensing apparatus is a water
10 spray mechanism.

13. A machine as set forth in claim 11, wherein the re-boiler tank further comprises a steam-based heat exchanger.

15 14. A machine as set forth in claim 11, further comprising a mix tank, wherein the re-condensed non-aqueous solvent is pumped from the recovery tank to the mix tank, where it is combined with appropriate chemicals to create the chemical mixture.

20 15. A machine as set forth in claim 12, wherein the application apparatus is selected from a group consisting of a foam applicator, spray applicator, and a padding applicator.

16. A machine as set forth in claim 15, wherein the removal apparatus is a squeeze
25 roller.

17. A machine as set forth in claim 16, wherein the evaporator apparatus is a heat exchanger.

18. A machine as set forth in claim 17, wherein the heat exchanger is a steam-based heat exchanger.

19. A machine as set forth in claim 18, wherein the blower apparatus comprises an item selected from a group consisting of a fan, and a blower.

5 20. A machine as set forth in claim 19, wherein the separator comprises a mist eliminator and a high efficiency separator, further removing solvent vapors.

10 21. A machine as set forth in claim 20, wherein the re-boiler tank further comprises a steam-based heat exchanger.

15 22. A machine as set forth in claim 21, further comprising a mix tank, wherein the re-condensed non-aqueous solvent is pumped from the recovery tank to the mix tank, where it is combined with appropriate chemicals to create the chemical mixture.

20 23. A machine as set forth in claim 22, further comprising an additional application apparatus, where the chemical mixture is applied to an additional side of the substrate.

25 24. A method for applying a chemical solution to a substrate, comprising the acts of: forming a chemical mixture comprising a non-aqueous solvent and a chemical solute;

applying the chemical mixture with the substrate forming a wet substrate; and removing the non-aqueous solvent from the wet substrate, leaving a substrate with remaining chemical solution.

30 25. A method of claim 24, furthering comprising an act of selecting an application apparatus before the act of applying the chemical mixture with the substrate, the

application apparatus is selected from a group consisting of a foam applicator, spray applicator, and a padding applicator.

26. A method of claim 24, wherein the act of removing the non-aqueous solvent from
5 the wet substrate comprises the acts of:

removing a portion of the chemical mixture from the wet substrate,
leaving a substrate with remaining chemical mixture;
lowering a boiling point of the non-aqueous solvent in the substrate with
remaining chemical mixture;
10 and evaporating the non-aqueous solvent into a solvent vapor.

27. A method of claim 26, further comprising an act of using a squeeze roller as a
removal apparatus, before the act of removing a portion of the chemical mixture
from the wet substrate.

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28. A method of claim 26, further comprising an act of using a heat exchanger as an
evaporator apparatus, before the act of evaporating the non-aqueous solvent into a
solvent vapor.

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29. A method of claim 28, further comprising an act of using a steam-based heat
exchanger as the heat exchanger.

30. A method of claim 26, further comprising an act:

of preventing vapors from escaping by creating a negative pressure; and
25 removing remaining solvent vapors.

31. A method of claim 30, further comprising an act of selecting a blower apparatus
before the act of preventing vapors from escaping by creating a negative pressure,
the blower apparatus being selected from a group consisting of a fan, and a
30 blower.

32. A method of claim 30, further comprising an act of using a separator comprising a mist eliminator and a high efficiency separator, before the act of removing remaining solvent vapors.

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33. A method of claim 30, further comprising an act of collecting any removed non-aqueous solvent.

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34. A method of claim 33, wherein the act of collecting any removed non-aqueous solvent comprises acts:

of pushing the solvent vapor into a vapor scrubber chamber via the negative pressure;

condensing the solvent vapor into a condensed liquid solvent solution;

collecting the condensed liquid solvent solution and the portion of the

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chemical mixture into a collected solution;

heating the collected solution to vaporize the non-aqueous solvent into a re-vaporized non-aqueous solvent;

cooling and condensing the re-vaporized non-aqueous solvent into a re-condensed non-aqueous solvent; and

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collecting the re-condensed non-aqueous solvent in a recovery tank.

35. A method of claim 34, further comprising an act of using a water spray mechanism as a condensing apparatus, before the act of condensing the solvent vapor into a condensed liquid solvent solution.

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36. A method of claim 34, further comprising an act of using a steam-based heat exchanger as the heating method for the re-boiler tank, before the act of heating the collected solution to vaporize the non-aqueous solvent into a re-vaporized non-aqueous solvent.

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37. A method of claim 34, further comprising an act of pumping the re-condensed non-aqueous solvent from the recovery tank to a mix tank, where it may be combined with appropriate chemicals to create the chemical mixture.

5 38. A method of claim 37, further comprising an act of pumping the chemical mixture to the application apparatus.

10 39. A method of claim 35, furthering comprising an act of selecting an application apparatus before the act of applying the chemical mixture with the substrate, the application apparatus being selected from a group consisting of a foam applicator, spray applicator, and a padding applicator.

15 40. A method of claim 39, further comprising an act of using a squeeze roller as a removal apparatus, before the act of removing a portion of the chemical mixture from the wet substrate.

20 41. A method of claim 40, further comprising an act of using a heat exchanger as an evaporator apparatus, before the act of evaporating the non-aqueous solvent into a solvent vapor.

42. A method of claim 41, further comprising an act of using a steam-based heat exchanger as the heat exchanger.

25 43. A method of claim 42, further comprising an act of selecting a blower apparatus before the act of preventing vapors from escaping by creating a negative pressure, the blower apparatus being selected from a group consisting of a fan, and a blower.

44. A method of claim 43, further comprising an act of using a separator comprising a mist eliminator and a high efficiency separator, before the act of removing remaining solvent vapors.

5 45. A method of claim 44, further comprising an act of using a steam-based heat exchanger as a re-boiler tank, before the act of heating the collected solution to vaporize the non-aqueous solvent into a re-vaporized non-aqueous solvent.

10 46. A method of claim 45, further comprising an act of pumping the re-condensed non-aqueous solvent from the recovery tank to a mix tank, where it may be combined with appropriate chemicals to create the chemical mixture.

47. A method of claim 46, further comprising an act of pumping the chemical mixture to the application apparatus.

15 48. A method of claim 47, further comprising an act of pumping the chemical mixture to an additional application apparatus, where the chemical mixture is applied to an additional side of the substrate.

20 49. A machine for applying a chemical solution to a substrate, comprising:
a means for forming a chemical mixture comprising a non-aqueous solvent and a chemical solute;
a means for applying the chemical mixture with the substrate, forming a wet substrate; and
a means for removing the non-aqueous solvent from the wet substrate, leaving substrate with remaining chemical solution.

25 50. A machine as set forth in claim 49, wherein the means for applying the chemical mixture with the substrate, forming a wet substrate, is selected from a group consisting of a foam applicator, spray applicator, and a padding applicator.

51. A machine as set forth in claim 49, wherein the means for removing the non-aqueous solvent from the wet substrate comprises:

- 5 a means for removing a portion of the chemical mixture from the wet substrate, leaving a substrate with remaining chemical mixture;
- 10 a means for lowering a boiling point of the non-aqueous solvent in the substrate with remaining chemical mixture; and
- 15 a means for evaporating the non-aqueous solvent into a solvent vapor.

52. A machine as set forth in claim 51, wherein the means for removing a portion of the chemical mixture from the wet substrate, is a squeeze roller.

53. A machine as set forth in claim 51, wherein the means for evaporating the non-aqueous solvent into a solvent vapor is a heat exchanger.

15 54. A machine as set forth in claim 53, wherein the heat exchanger is a steam-based heat exchanger.

55. A machine as set forth in claim 51, further comprising:

- 20 a means for preventing vapors from escaping by creating a negative pressure; and
- 25 a means for removing remaining solvent vapors.

56. A machine as set forth in claim 55, wherein the means for preventing vapors from escaping by creating a negative pressure, is selected from a group consisting of a fan, and a blower.

30 57. A machine as set forth in claim 55, wherein the means for removing remaining solvent vapors, is a separator comprising a mist eliminator and a high efficiency separator.

58. A machine as set forth in claim 55, further comprising a means for collecting any removed non-aqueous solvent.

5 59. A machine as set forth in claim 58, wherein the means for collecting any removed non-aqueous solvent comprises:

 a means for pushing the solvent vapor into a vapor scrubber chamber via a negative pressure;

10 a means for condensing the solvent vapor into a condensed liquid solvent solution;

 a means for collecting the condensed liquid solvent solution and the portion of the chemical mixture into a collected solution;

15 a means for heating the collected solution to vaporize the non-aqueous solvent into a re-vaporized non-aqueous solvent;

 a means for cooling and condensing the re-vaporized non-aqueous solvent into a re-condensed non-aqueous solvent; and

 a means for collecting the re-condensed non-aqueous solvent.

60. A machine as set forth in claim 59, wherein the means for condensing the solvent vapor into a condensed liquid solvent solution, is a water spray mechanism.

20 61. A machine as set forth in claim 59, wherein the means for heating the collected solution to vaporize the non-aqueous solvent into a re-vaporized non-aqueous solvent, is a steam-based heat exchanger.

25 62. A machine as set forth in claim 59, further comprising a means for pumping the re-condensed non-aqueous solvent from a recovery tank to a mix tank, where it may be combined with appropriate chemicals to create the chemical mixture.

63. A machine as set forth in claim 62, further comprising a means for pumping the chemical mixture to the application apparatus.

5 64. A machine as set forth in claim 60, wherein the means for applying the chemical mixture with the substrate, forming a wet substrate, is at least one item selected from a group consisting of a foam applicator, spray applicator, and a padding applicator.

10 65. A machine as set forth in claim 64, wherein the means for removing a portion of the chemical mixture from the wet substrate, is a squeeze roller.

66. A machine as set forth in claim 65, wherein the means for evaporating the non-aqueous solvent into a solvent vapor is a heat exchanger.

15 67. A machine as set forth in claim 66, wherein the heat exchanger is a steam-based heat exchanger.

68. A machine as set forth in claim 67, wherein the means for preventing vapors from escaping by creating a negative pressure, is at least one item selected from a 20 group consisting of a fan, and a blower.

69. A machine as set forth in claim 68, wherein the means for removing remaining solvent vapors, is a separator comprising is a mist eliminator and a high efficiency separator.

25 70. A machine as set forth in claim 69, wherein the means for heating the collected solution to vaporize the non-aqueous solvent into a re-vaporized non-aqueous solvent, is a steam-based heat exchanger taking the form of a re-boiler tank.

71. A machine as set forth in claim 70, further comprising a means for pumping the re-condensed non-aqueous solvent from the recovery tank to a mix tank, where it may be combined with appropriate chemicals to create the chemical mixture.
- 5 72. A machine as set forth in claim 71, further comprising a means for pumping the chemical mixture to the application apparatus.
73. A machine as set forth in claim 72, further comprising a means for pumping the chemical mixture to an additional application apparatus.
- 10 74. A machine as set forth in claim 73, further comprising a means for applying the chemical mixture to an additional side of the substrate.

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